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A THUNDERSTORM DISCHARGE ARTIFICIALLY PRODUCED IN WINTER

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Unstable stratification of air masses up to 2.5 to 3 km is often observed in winter in the south Barents Sea and on the Murmansk coast. This is caused by warming of cold Arctic air when it passes over the nonfreezing part of the Barents Sea. The unstable stratification results in the development of extensive cumulus cloudiness and showers, accompanied by squall winds and poor visibility.

The cloudiness does not develop to thunderstorm proportions, however, and thunderstorms, similar to those found on the Norwegian coast, are not observed on the south Barents Sea and the Murmansk coast. Nevertheless, a case of an electrical discharge caused artificially by the ascent of barrage balloons has been observed in winter.

This case occurred at 1945 hours on 7 December 1943, in Murmansk, with the following synoptic background:

On 7 December, there was a vast slowly filling depression over the entire northwest European USSR, Scandinavia, and the Barents Sea, thus creating conditions favoring advection of Arctic air in its back areas, i.e., in the regions of Scandinavia, including Finland, and the Kola Peninsula. This advection was rather slow, in contrast to the usually rapid intrusion of Arctic air into the rear areas of cyclones which form and develop in the Arctic front.

The presence of the massive cumulo-nimbus clouds observed at the Murmansk Hydrometeorological Station and at other stations around Murmansk was due to instability, although not very pronounced, in the stratification of the Arctic air mass.

The intermittent cloudiness (mainly cumulo-nimbus clouds) with heavy rains falling from time to time and the gentle breezes alternating with complete calm made conditions quite favorable for setting up barrage balloons over the objects to be defended.

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Several balloons were sent up to a height of 2,000 m. Almost immediately after ascent, the winches of several balloons began to spark, indicating the high potential of the electric field in the atmosphere. The sparking became more intense when weakly developed cumulo-nimbus clouds passes overhead. These cumulo-nimbus clouds were accompanied by snowfall.

At about 1940 hours, another balloon was launched, which at 1945 had reached a height of 300 meters. In ascending, the balloon entered into an advancing cumulo-nimbus cloud. At that moment, it exploded, accompanied by an intense discharge through the winch. A second balloon, located at a height of 2,000 m and 2 km distant from the first, exploded at the same time.

For a discharge to occur between two plates separated by a dielectric with a potential difference between them, either this potential difference must be increased or the distance between the plates must be decreased. Apparently, the latter was the case in the explosion of the balloons. The entrance of the hydrogen-filled balloon, which probably had a negative charge the same as the earth (since it was connected with the earth by a cable through the winch), into the cumulus cloud, the lower part of which apparently had a positive charge, created a unique condenser with the plates close together (the cumulus cloud, on the one hand, and cables and hydrogen of the balloon connected with the earth, on the other), between which there was an insulator (the envelope of the balloon).

The positive charge on the envelope of the balloon may have been increased in connection with the precipitation which had started to fall and the possible condensation of the precipitation on the outside of the envelope. These conditions may have promoted union of the separate charges on the snowflakes.

Under such circumstances, as soon as the potential difference reached a critical value for an insulator of this type, discharge or the so-called breakdown of the condenser insulation took place, causing instantaneous explosion of the hydrogen.

However, similar cases have not been observed up to now, despite almost 2 years of practical activity of the balloon unit in this region. This might be explained by the fact that balloons are not used in winter when cumulo-nimbus clouds are present, since cumulo-nimbus clouds are usually accompanied by very poor weather. In the summer period, during the polar day, barrage balloons are generally not released.

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